Left atrial hybrid closure of muscular ventricular septal defects with the Amplatzer device

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Muscular ventricular septal defects (mVSDs), whether dealt with as a single lesion or as a complex of congenital heart disease, are fraught with difficulty. Pulmonary artery bands are palliative, and ventriculotomies initiate scarring. Simple single mVSDs are difficult to visualize from a right atrial approach because they are commonly in the apex, whereas multiple mVSDs have muscular septations within the right ventricular cavity, making it difficult to visualize a defined edge for optimal patch opposition, leaving residual shunts. Transcatheter occluders have been placed in the ventricular septum percutaneously,[1] perventricularly,[2,3] and intraoperatively.[4] In general, a significant amount of experience and resources are necessary to perfect the percutaneous/perventricular techniques, whereas the direct intraoperative approach is more straightforward. Furthermore, cardiopulmonary bypass (CPB) is often necessary for other associated complex congenital lesions. We present a simple hybrid-type approach to close mVSDs during cardioplegic arrest using an Amplatzer duct occluders (AGA Medical, Golden Valley, Minn) through the left atrium in a patient with D-transposition of the great arteries.

CLINICAL SUMMARY

After dissection of the great vessels, exposure of the superior left atrium, and ascending aortic and bicaval cannulation, CPB is initiated and cardioplegia is administered. Through a right atriotomy, the right ventricle is inspected for the mVSD. A right angle from the left ventricle through the ventricular septal defect (VSD) into the right ventricle can assist in visualizing the defect (Figure 1). Access to the left ventricular cavity includes a patent foramen ovale, Waterson's groove, and the dome/roof of the left atrium. Using the patent foramen ovale to access the left heart requires a moderate degree of angulation to cross the mitral valve and acutely pass back through the VSD. An anterior superior left atriotomy, as is often used when repairing supracardiac total anomalous pulmonary venous return,[5] provides an excellent angle to pass a right angle through the VSD without significant torque across the mitral valve apparatus. The aorta can be retracted left or right or divided to access the left atrium while the pulmonary artery is retracted laterally. After a superior left atriotomy, a right angle is passed across the mitral valve through the mVSD and into the right ventricle. A 0.035-inch exchange guidewire is passed through the tricuspid valve to the right angle and pulled up through the mitral valve and out the left atriotomy. Preoperative echocardiography, angiography, or both is used to determine device size. A 6F to 7F 13-cm kink-resistant Flexor sheath (Cook, Inc, Bloomington, Ind) is passed over the guidewire from the right atrium through the mVSD into the left ventricle, and the wire and dilator are removed. Deployment was under direct vision in the usual fashion, except the luer-lock loader was shortened before sheath insertion, and several securing sutures were placed on the right ventricular septum (Figure 2). Subsequently, an arterial switch operation was performed, and an echocardiogram revealed a trivial residual shunt.

DISCUSSION

Depending on the dimensions and number of defects, septal thickness, and patient size, one can select one of several different AGA Medical–designed Amplatzer occluders. The Duct Occluder has the smallest profile and is ideal for neonates with single defects. The mVSD occluder has 2 large concentric discs and a 7-mm waist to accommodate the thicker portion of the ventricular septum. The Multi-Fenestrated Septal Occluder, ''Cribiform,'' was designed to close multifenestrated atrial septal defects but might be suitable for ''Swiss cheese'' mVSDs. A narrow waist allows placement through a central hole in the septal wall, and the discs cover the surrounding holes.

Advantages of the operative–hybrid technique with the Amplatzer Duct Occluder on the arrested heart include no limitations on patient weight or device size, preservation of the mitral valve apparatus, direct visualization of device placement, and suture stabilization. Furthermore, one can avoid ventricular incisions, muscle transection, access of the arterial system, or crossing of the aortic valve and septal suturing, thus preserving septal function. If the device is imperfectly positioned, the device can be removed and repositioned.

Disadvantages compared with the percutaneous approach for isolated mVSDs include a sternotomy, CPB, and length

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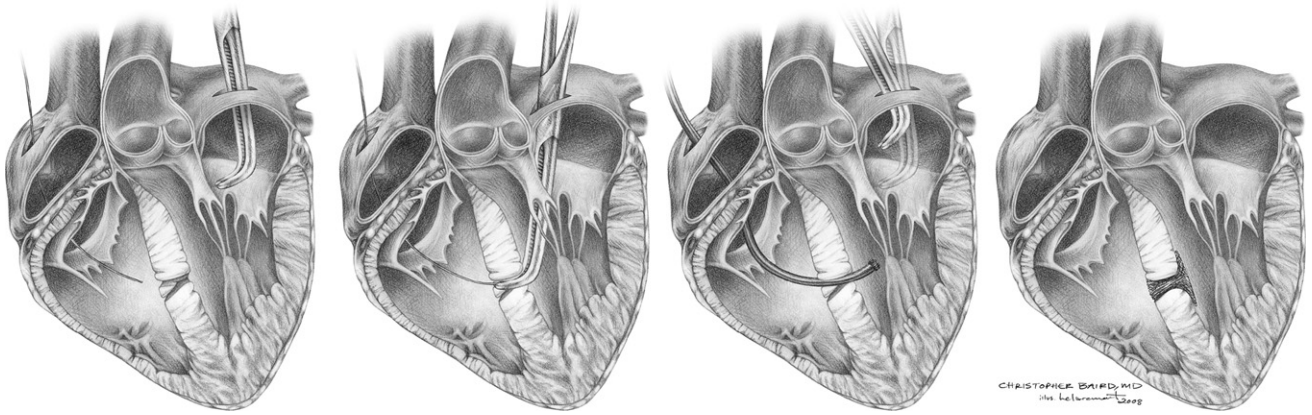

FIGURE 1. Superior left atrial approach for hybrid closure of a muscular ventricular septal defect.

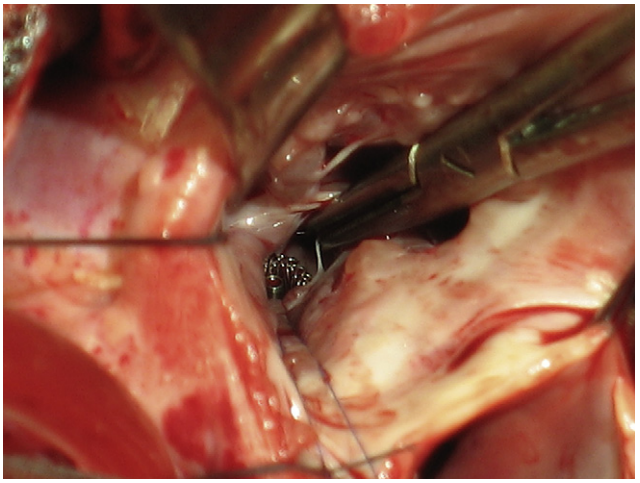

FIGURE 2. View from the right atrium securing an Amplatzer patent ductus arteriosus occluder in the muscular septum.

of stay. However, compared with patch closure, the hybrid approach offers a reduction in CPB and myocardial ischemic times. When other lesions are involved requiring simultaneous repair, there are no advantages to the percutaneous approach; the perventricular approach would shorten CPB times, but the operative–hybrid approach offers the aforementioned advantages with less risk. The perventricular approach is preferred for small neonates with simple isolated mVSDs, allowing the avoidance of CPB and simple access.

This hybrid approach to close mVSDs with CPB and Amplatzer occluders is a simple, highly effective, and efficient approach requiring minimal experience to perform. The more direct approach from the superior left atrium reduces angulation across the mitral valve and allows visualization of the left ventricular cavity. When CPB is necessary, this technique can improve functional results and minimizes the potential for complications.Acknowledgment

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